REMARKS

Reconsideration of this application is respectfully requested.

The rejection of claims 1-10 under 35 U.S.C. §102 as allegedly anticipated by Konzelmann is respectfully traversed.

Contrary to the Examiner's comments, Konzelmann discloses a flow amount detector R_s which is not disposed either upstream or downstream of the heater resistance R_H. Instead, as clearly depicted in the front and rear views of Figures 2 and 3 (and in the corresponding text), these two resistors are located exactly coextensively at the same fluid flow location. Indeed, they are expressly placed in intimate good thermal contact with one another so that they are always at essentially the same temperature (e.g., see column 3, lines 12-14 and column 6, lines 10-21).

Konzelmann is primarily concerned with accurately measuring the amount of fluid flow in a pulsating uni-directional situation. To this end, a properly dimensioned slit 50 is interposed between the compensation leg 40 and the downstream heater/sensor leg 41. By taking advantage of thermal inertia, the uni-directionally pulsating flow may be accurately averaged to give an approximately correct average uni-directional flow amount.

It is true that Konzelmann occasionally mentions that such pulsating flow may be so great as to even cause back flows from time to time (e.g., see the couple of lines of the

Abstract and column 5, lines 40-50). However, as explained at column 5, lines 40-50, the "markedly improved measuring result, even when back flows occur in the measuring duct" is due to the wide slit 50 and the boundary layer that forms along the measuring resistor being not as thick as when a relatively narrow slit is used. Thus even when a back flow occurs, "the increased indication of mass flow due to back flow is reduced by the measuring element as a result of this smaller boundary-layer thickness." (column 5, lines 47-50).

That is, Konzelmann does not teach a technique that can accurately measure the true net fluid flow amount (i.e., the forward direction fluid flow minus the backward direction fluid flow).

One of the reasons Konzelmann does not achieve accurate flow measurements when back flow occurs is because the flow detector and heater are in intimate thermal contact on opposite sides of the same substrate 25 at the downstream leg 41 -- at exactly the same position in the stream of flowing fluid (i.e., contrary to the Examiner's remarks, the flow detector is not disposed either upstream or downstream of the heater).

The present invention enables the flow amount measuring apparatus to detect both t he fluid flow amount and the fluid flow direction. For this purpose, as recited in independent claims 1 and 22, the heater 30 and the flow amount detector 21 are arranged at different positions in the fluid flow direction. In this manner, detector 21 is arranged to produce an output which varies with both the fluid flow amount and the fluid flow

direction. More specifically, as recited in claims 8, 14, 17 and 18, the heater 30 is constructed to have a sufficient width in the fluid flow direction so that its thermal influence on the flow amount detector varies with the fluid flow direction.

In Konzelmann, as shown in Figure 2 (front view) and Figure 3 (rear view), the heater R_H and the detector (resistor) R_s are disposed at the same position in the fluid flow direction. As a result, the thermal influence of the heater on the detector does not vary with the fluid flow direction. Further, the detector is used to control the heater so that the resistance (temperature) of the detector is controlled to a fixed value. As a result, the flow amount and the flow direction cannot be measured from the output of the detector itself. Therefore, the present invention (claim 1 and its dependent claims) is not anticipated.

The rejection of claims 11-16 under 35 U.S.C. §103 as allegedly being made "obvious" based on the combination of Konzelmann and Hiromasa et al '698 is also respectfully traversed.

Fundamental deficiencies of the primary reference have already been noted above with respect to independent claim 11.

In Hiromasa et al, similar to Konzelmann, the detector (resistor) 11 is used to control the heater 10 as well as the detector 12. The output of the detector 11 itself is not used to detect the flow amount and the flow direction. Therefore, even if Hiromasa et al

is combined with Konzelmann, the invention of claim 11 and its dependent claims is not achieved, and hence is not obvious.

New dependent claims 17 and 18 depend respectively from claims 1 and 11 and are also believed to be allowable because they add yet further patentable distinctions to the claimed invention.

New claims 19-48 define a fluid flow amount and direction measuring apparatus (claims 19-34) and a fluid flow amount and direction measuring method (claims 35-48). Independent claim 9 requires, inter alia, that the fluid flow detector be disposed upstream or downstream of the controllable heater and provide a temperature dependent resistance that is a predetermined function of both fluid flow amount and fluid flow direction. Independent method claim 35 requires detecting fluid flow at a location upstream or downstream of a controllable heater and providing a temperature dependent resistance that is a predetermined function of both fluid flow amount and fluid flow direction. The dependent claims from these two independent claims are believed to add yet further patentable distinction to the claimed invention.

Accordingly, this entire application is now believed to be in allowable condition and a formal Notice to that effect is respectfully solicited.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached page(s) is captioned "**Version With Markings To Show Changes Made**."

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION

The paragraph beginning at page 1, line p:

The present invention relates to a fluid flow [amount] measuring apparatus [for measuring a fluid flow amount].

The paragraph beginning at page 1, line 12:

A thermal-type flow [amount] meter is used as a flow [amount] measuring apparatus to measure [an] the amount of intake air [amount of] for an internal combustion engine of automotive vehicles or the like. In [the] an engine of not more than four cylinders, intake air pulsation increases when it is in a low rotational speed and high load condition. [When] If opening periods of an intake valve and an exhaust valve overlap when the intake air flow is pulsating, the intake air is [like] likely to flow in a reverse direction through the intake valve when a piston moves upward. The air flowing in reverse also is detected as [the] an additional intake air flow amount. As a result, the amount of intake air flow [amount] which is actually sucked into [a] the combustion chamber cannot be detected accurately.

The paragraph beginning at page 1, line 24:

A flow [amount] meter disclosed in JP-B2-62-14705 measures [an] intake air flow [amount] by correcting [an] average flow [amount] based on engine operating condition parameters such as [an] engine rotational speed and [a] throttle opening [degree], so that

[the] fluid flow [amount] may be measured [in consideration] as a function of the direction of fluid flow. However, [the] intake air flow amount cannot be measured with high accuracy, because [the] intake air pulsation accompanied by [the] reverse flow cannot be simply determined from [the] engine rotational speed and [the] throttle opening [degree].

The paragraph beginning at page 2, line 8:

A flow [amount] meter disclosed in JP-A-61-213728 determines that [an] intake air flow direction is reversed when a plurality of singular points of a function appear[s] in detected flow amount values. It is however difficult to accurately detect [the] reversal of the intake air flow from [the] detection of the singular points of a function, because [the] pulsation in [the] intake air flow is influenced largely by [the] types of engines and intake air duct configurations.

The paragraph beginning at page 2, line 16:

A flow [amount] meter disclosed in JP-A-1-185416 detects [an] intake air flow direction from a difference between detection signals of two heaters disposed at an upstream side and a downstream side of a planar substrate. However, [a] control circuit construction is complicated, because two control circuits are required to detect signals from each heater. In addition, [a] the temperature change rate of each heater at the time of heating operation may differ from each other, because it is difficult to match control constants of the two control circuits. Errors will occur in the difference between [the]

temperatures of the heaters, thus disabling an accurate detection of [the] intake air flow direction.

The paragraph beginning at page 3, line 1:

Flow [amount] meters and flow speed sensors disclosed in JP-A-8-14978, JP-A-60-142268 and JP-A-6-160142 detect[s an] intake air flow direction from a difference between detection signals of two temperature sensors which are disposed at an upstream side and a downstream side of a heater. However, a sensing part including an intake air temperature sensor becomes large and the heat capacity of the sensing part increases, because the temperature sensors are disposed upstream and downstream of the heater. As a result, [the] detection sensitivity and responsiveness of the flow [amount] meter will be lessened.

The paragraph beginning at page 3, line 11:

A flow [amount] meter disclosed in JP-A-10-62220 expands [a] the measurable range and decreases [a] the ratio of noise relative to an output signal by arranging a heater to surround a group of temperature measuring resistors and increasing [a] the difference between the temperatures of temperature measuring resistors of the group disposed at an upstream side and a downstream side in the group with respect to [a] fluid flow direction. However, a sensing part becomes large and the heat capacity of the sensing part increases, because the heater surrounds the group of the temperature measuring resistors. As a result, [the] detection sensitivity and responsiveness of the flow [amount] meter will be lessened.

The paragraph beginning at page 3, line 23:

It is an object of the invention to provide a small-sized flow [amount] measuring apparatus which detects [a] flow amount with high accuracy irrespective of fluid flow direction.

The paragraph beginning at page 3, line 26:

According to a preferred embodiment of the present invention, a heater is strip-shaped in a manner that each strip turns at a plurality of points and has a width in a flow direction. The temperature of the heater is controlled to a reference temperature determined in correspondence with a temperature detected by a fluid temperature detector. A flow amount detector is disposed at only one of an upstream side and a downstream side of the heater with respect to one fluid flow direction, so that [a] fluid flow amount varying with [a] fluid flow direction is detected from the temperature detected by the flow amount detector.

The paragraph beginning at page 15, line 27:

In a sixth embodiment shown in Figs. 12A, 12B and 13, the intake air temperature detectors 20 and 22 are disposed at locations where the heat of the heater 30 does not influence the intake air temperature detecting operations. The control circuit is constructed as shown in Fig. 13 so that the temperatures, that is, resistances, of the flow amount detector 21 and the intake air temperature detector 22 function as the fluid temperature detector. The potential at the junction 52 between the intake air temperature detector 22 and the fluid amount detector 21 which changes its temperature in response to

changes in the intake air temperature does not change. It rather changes in response to the intake air flow amount and the direction of the intake air flow which the fluid amount detector 21. Therefore, the intake air flow direction and the intake air flow amount are measured irrespective of changes in the intake air temperature by applying the potential at the junction 52 and a predetermined fixed potential to one and the other inputs of the amplifier 46, respectively.

The paragraph beginning at page 19, line 7:

In the foregoing embodiments for implementing the present invention, the intake air flow amount is detected while taking into consideration the intake air flow direction by determining whether the temperature detected by the flow amount detector 21 is higher or lower than the reference temperature. However, the temperature detected by the flow amount detector 21 [in response] responds to changes in the distance between the flow amount detector 21 and the heater. For instance, if the flow amount detector 21 is distanced away from the heater, the temperature detected by the flow amount detector 21 may become lower than the reference temperature even if the flow amount detector 21 is located at the downstream side of the heater with respect to the intake air flow in the forward direction. Therefore, it is possible to compare the temperature detected by the flow amount detector 21 and a temperature different from the reference temperature but determined to variably change with the reference temperature based on the distance between the flow amount detector 21 and the heater 30.

IN THE CLAIMS

Amend claim 11 as shown below:

11. (Amended) A flow amount measuring apparatus comprising:

a substrate;

a heater formed on the substrate and controllable to a first reference temperature;

a first temperature detector formed on the substrate at a position upstream of the heater;

a second temperature detector formed on the substrate at a position close to the heater, said second temperature detector being disposed at one of the upstream and downstream sides of the heater;

a control circuit connected to the heater, the first temperature detector and the second temperature detector and including a heater control part and a flow amount measuring part, the first temperature detector being for detecting a first temperature and connected to at least one of the heater control part and the flow amount measuring part, the second temperature detector being connected to the flow amount measuring part, and the flow amount measuring part producing an output varying with a difference between a second temperature detected by the second temperature detector and a second reference temperature and with a flow direction of fluid passing along the substrate.